Amendments to the Drawings:

The attached sheets of drawings includes changes to Figures 3 and 8. These sheets replace the original sheets for Fig. 3 and 8.

Attachment: Replacement Sheet

REMARKS/ARGUMENTS

Claims 1-37 are pending in the present application.

Figures 3 and 8 are objected to as obscure. Amended replacement figures are enclosed with the present Amendment.

We gratefully acknowledge the Examiner's allowance of claims 31-35. The remaining claims are rejected in view of the following cited prior art.

Claims 1-12, 15, 16, 19-30 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,614,060 of Wang et al. ("Wang"). As amended by the present Amendment, independent claim 1 is directed to a sequential resonant tunneling p-i-n device comprising as one critical component an i type semiconductor layer comprising a number of III-nitride multiple quantum well layers of the same thickness. Claims 2-12, 15, 16 and 19-30 are all dependent on claim 1, and therefor contains the same limitations as claim 1. The presently rejected claims differ from Wang for the following reasons:

1) The active region in the presently claimed device consists of multiple quantum wells with the same well thickness while the device of Wang et. al. requires a two well system with different well thicknesses. One well **must** be wider than the other one. See column 1 lines 23-26 and column 4 lines 19-25 and claims 1, 7 and 8 of Wang. It is strictly required in Wang that one well must be coupled to the other well that has different well width in order to make the device functional for charge asymmetric resonance tunnelling.
2) The electron tunneling mechanisms are different between the presently claimed device and that disclosed in Wang. Electron tunneling in the presently claimed device is sequential resonant tunneling that requires identical well thicknesses for each active well. This means that the energy position of the ground state of a quantum well must be equal to the energy position of the first excited state of an adjacent quantum well. See Figure 4 of the present application.

Electron tunneling in the device of Wang is charge asymmetric resonance tunneling that requires different well widths. See column 4, lines 19-25 of Wang. This tunneling means that the energy position of the wide well bottom must be equal to the energy position of the subband minimum of the active quantum well, and one well must be wider than the other, column 1, lines 47-52.

3) The presently claimed device makes use of photo-generated carriers while no photo-generated carriers are involved in the disclosed device of Wang. See abstract of the present application. Wang teaches the use of radiative recombination of electrons and holes for LED application, while no radiative recombination is involved in the presently claimed invention. See column 1 lines 4 and 6-8 of Wang. The device of Wang requires current injection by applying a forward bias and will not work as a LED under reversed bias, while the presently claimed device only works under reversed bias and will not work under a forward bias.

Accordingly, it is respectfully requested that the rejection of claims 1-12, 15, 16, 19-30 under 35 U.S.C. 102(e) as being anticipated by Wang be withdrawn.

Claims 1-30 are rejected under 35 U.S.C. 103(a) as unpatentable in view of Wang. The Examiner specifically cites the presently pending claims 13, 14, 17 and 18 directed to multiple quantum wells comprising the same thickness barriers and same material as being taught by Wang in column 3. Contrary to the Examiner's statement, this cited portion of Wang does not teach that the barrier layers are of the same thickness (as recited in claim 13 of the present application), nor that the well layers are of the same thickness (as required in all of claims 1-30, as presently amended). Accordingly, it is respectfully requested that the rejection of claims 1-30 under 35 U.S.C. 103(a) as unpatentable in view of Wang be withdrawn.

Claims 1-30 are rejected under 35 U.S.C. 103(a) as unpatentable in view of Raisky et al. Applied Physics Letters vol. 7, No. 01, page 430 (July 16, 2001) in combination with U.S. Patent Application 2002/0096675 of Cho et al. We respectfully traverse.

As stated by the Examiner, Raisky teaches a p-i-n photovoltaic structure that comprises InGaAsP/InP, not the III-nitride material required by the presently claimed device. From the suggested combined teachings of Raisky and Cho, it is possible to construct a p-i-n photovoltaic structure with GaN based material, however the structure of the i-region suggested by the combination of Raisky and Cho, which is called the core region in Cho, is quite different from that of the presently claimed device and sequential resonant tunneling is not realizable in the i-region. The reasons are:

1) The i-region of device disclosed in Cho comprises two quantum well interior regions with different widths. See paragraph [0041] of page 4, claims 1-3 and 8 and figures 8A-8E of Cho. The core region of presently claimed device consists of multiple quantum wells with the same well width.
2) The two quantum well regions of the device disclosed in Cho cannot be identical in order to produce a superlattice barrier using one quantum well region. See claims 1-3, 8 and 16 and figures 8A-8E of Cho. The presently claimed device allows for identical quantum wells in the core region. See claims 13 and 14 of the present application.
3) The core region of the device disclosed in Cho requires n-type doping at a least one quantum well region. See claims 10-11, 17 and 20 and figures 8A-8E, and the suggested doping level is $0.1\text{-}1.0\text{x}10^{20}\text{cm}^{-3}$, paragraph [0042] of page 4 and claims 10-11 of page 10 of Cho. The core region of the presently claimed device is undoped or doped by compensation to make the core region semi-insulate. See page 11, paragraph 26. Claim 1 has been amended by the present Amendment to recite this characteristic of the multiple quantum wells to clearly distinguish the presently claimed invention from Cho.
4) Since sequential resonant tunneling requires identical well width and doping level for each quantum well, it will not occur in the core region of Cho's device where the quantum wells are not identical. This means that Cho's device cannot function as a sequential resonant tunneling device even if it is incorporated into a p-i-n structure taught by Raisky. In contrast, the presently claimed device is a sequential resonant tunneling device.

5) When working as an optically pumped infrared emitter, the presently claimed device operates in sequential resonant tunneling condition that leads to amplification of infrared photon emissions. This means that the infrared emitter emits more than one infrared photons for each incident photon. The infrared emitter taught by Cho is not able to achieve this amplification of photon number since it cannot work by sequential resonant tunneling.

6) The semiconductor materials used in quantum well layers of the presently claimed device are III-Nitrides, and are different from those used by Raisky, which are InGaAs/InP materials. Cho teaches a GaN based material for its device, but Cho's device is so fundamentally different from the device taught by Raisky one of ordinary skill in the art would not reasonably combine Raisky and Cho.

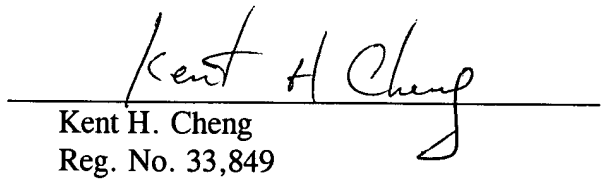
Accordingly, we respectfully request that the rejection of claims 1-30 under 35 U.S.C. 103(a) as unpatentable in view of Raisky in combination with Cho be withdrawn.

We believe that all the pending claims 1-37 are now in a condition for allowance, early notice of which is earnestly requested.

It is believed that no fees or charges are required at this time in connection with the present application; however, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,

COHEN, PONTANI, LIEBERMAN & PAVANE

By 

Kent H. Cheng
Reg. No. 33,849
551 Fifth Avenue, Suite 1210
New York, New York 10176
(212) 687-2770

Dated: July 18, 2005